

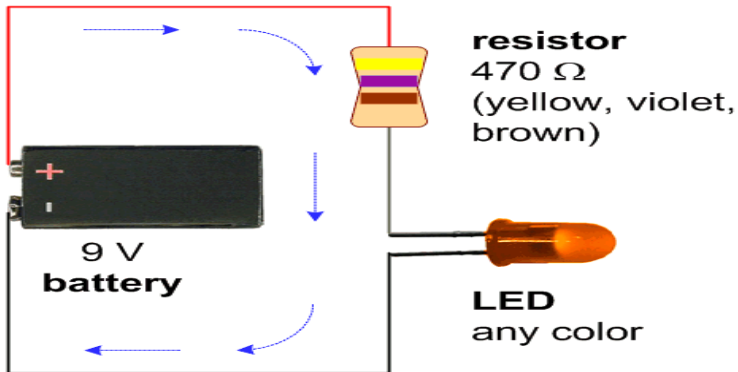
## 2.7 Electrical Resistance



- Recall, resistance is the ability of a material to \_\_\_\_\_ the flow of electric current.



- Resistors are electrical devices used in circuits to \_\_\_\_\_ the flow of electric current.



# Factors Affecting Resistance of a Wire

You can increase resistance by lengthening the wire, heating the wire, or using a metal with more resistance



You can decrease resistance by using a thicker wire, or using several wires, or using a metal with less resistance



### **Length**

Resistance \_\_\_\_\_ with length. This happens because electrons have to travel through more material.

If the length doubles, the resistance \_\_\_\_\_.

### **Cross-Sectional Area (thickness)**

Resistance \_\_\_\_\_ with area. Electrons flowing through a thicker wire have more room to move freely.

If the cross sectional area doubles, then the resistance is \_\_\_\_\_ the amount.

### **Temperature**

As the temperature of the wire \_\_\_\_\_, the resistance increases. When a wire gets warmer, the atoms that make up the wire gain energy and \_\_\_\_\_ faster. The increased vibration results in more \_\_\_\_\_ between atoms and the free-flowing electrons.

### **Type of Material**

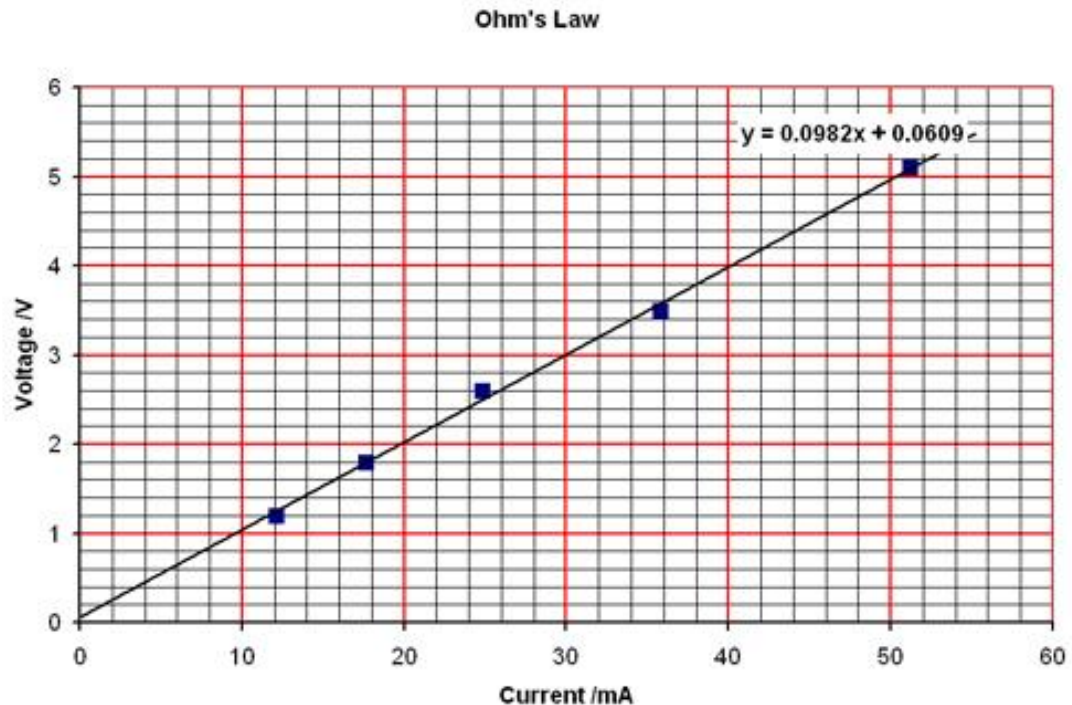
Due to the structure of their atoms, some metals allow atoms to move more \_\_\_\_\_ than others (Ex. conductors vs insulators).

# Ohm's Law

- When the potential difference across a wire changes, the current changes. Therefore, in a given circuit, increasing the voltage will increase the current.
- [animation](#)
- This circuit has **resistance** that is constant no matter how the voltage changes.

- This is shown as a straight-line relationship between voltage and current.

$$R = \frac{V}{I} \quad \text{Usually written as} \quad V = IR$$



- R (resistance) is measured in ohms. The unit symbol is  $\Omega$  (omega =  $\Omega$ )



# The resistance of a load is:

$$\text{Resistance} = \frac{\text{Potential difference across load (volts)}}{\text{Current through the load (amps)}}$$

# Written in Symbols:

$$R = \frac{V}{I}$$

Usually written as  
 $V = IR$



## **V, voltage**

Measured in volts V  
Is energy per unit of charge  
 $1V = 1 \text{ joule/coulomb}$

## **I, current**

Measured in amps A  
Is rate of flow of charge  
 $1A = 1 \text{ coulomb/second}$


## **R, resistance**

Measured in ohms  $\Omega$



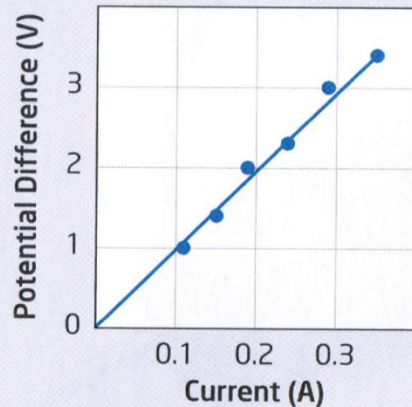
# Sample Questions

- A light bulb passes a current of  $0.83\text{ A}$  when the potential difference across the bulb is  $120\text{ V}$ . What is the electrical resistance of the bulb in ohms?

- 
- What is the potential difference across an electric wire heater that has a resistance of  $32\ \Omega$  when the current through it is  $6.8\ \text{A}$ ?
  - What is the resistance of a heating coil of an electric heater, if a current of  $12.5\ \text{A}$  runs through it and it is connected to a  $120\ \text{V}$  wall outlet?

# Practice Problems

Potential Difference  
vs. Current for a Resistor



## Practice Problems

1. In the graph on the left, the potential difference between the ends of a resistor in a circuit is plotted against the current through the resistor. What is the value of the resistance?
2. A television that is plugged into a wall socket has a potential difference of 120 V across its terminals. If the television uses a current of 1.45 A, what is its resistance?
3. A toaster uses a current of 10.4 A when it is plugged into a 110 V outlet. What is the resistance of the heating coils?
4. How will the current passing through a resistor change when the potential difference across the resistor is doubled?
5. The filament of a flashlight bulb has a resistance of  $40\ \Omega$ . If a 6.0 V battery is used in the circuit, what is the current?
6. A circuit board has a resistance of  $12\ \Omega$  and requires a current of 0.25 A. What potential difference is required to operate the circuit board?

# Practice Problems

## Review Questions

- A** 1. The current in an automobile headlight, which is connected to a 12 V battery, is 0.80 A. What is the resistance of the headlight?
- K/U** 2. The resistance of a particular circuit board is  $5.0\ \Omega$ . What potential difference must be supplied to the circuit board if it requires a current of 0.030 A to operate?
- K/U** 3. An electric motor has a resistance of  $7.41\ \Omega$ . What current is there through the motor when it is connected to a 100 V source?

**Read p. 441 to 443**